CLAIMS

I claim:

1. A method for joining fabrics, comprising the steps of:

measuring initial values of selected characteristics of said fabrics and all other materials intended to be included in the resulting joint;

calculating therefrom an optimal value for at least one control parameter for a said joint of desired quality that can be non-destructively applied to said joint;

organizing said fabrics and all other materials into an assemblage of the desired order for said joint;

applying heat and pressure to said assemblage while applying said control parameter until said optimal value of said control parameter is achieved.

2. A method for joining fabrics according to claim 1, said selected characteristics of said fabrics and all other materials comprising at least one from among the group consisting of thickness, volume, specific gravity, density, and opacity.

3. A method for joining fabrics according to claim 2, said at least one control parameter being joint thickness.

4. A method for joining fabrics according to claim 3, said applying said control parameter comprising applying said pressure with a pressing mechanism having a closed press limit about equal to said optimal value of said joint thickness.

5. A method for joining fabrics according to claim 4, said applying said control parameter comprising:

relieving said heat and pressure from a section of said joint and thereafter measuring the actual value of said joint thickness of said section;

comparing said actual value to said optimal value and providing a feedback signal for adjusting said closed press limit to correct said actual value towards said optimal value.

6. A method for joining fabrics according to claim 1, said step of calculating further comprising calculating therefrom an optimal value for at least one additional control parameter for a said joint of desired quality that may be destructively applied to samples of said joint; said method for joining fabrics further comprising the step:

correlating said optimal value of said at least one control parameter that can be non-destructively applied with said optimal value of said at least one additional control parameter that may be destructively applied.

7. A method for joining at least two fabric layers, comprising the steps:

providing at least two fabric layers;

saturating at least facing surfaces of the fabric layers with an adhesive;

providing an adhesive film between the fabric layers; and

applying heat and pressure to the fabric layers until a thickness of the joined fabric layers is reduced to not more than a predetermined optimal thickness for a joint of desired quality.

8. The method of claim 7, wherein the step of providing fabric layers comprises:

providing at least one fabric layer that includes fibers having a tenacity of 10g/denier or higher.

9. The method of claim 7, wherein the step of providing at least two fabric layers comprises:

providing at least one fabric layer consisting of woven yarns including fibers having a tenacity of 10g/denier or higher.

10. The method of claim 7, wherein the step of providing at least two fabric layers comprises:

providing two fabric layers including woven yarns that each include fibers having a tenacity of 10g/denier or higher.

11. The method of claim 7, wherein the step of providing at least two fabric layers comprises:

providing a first fabric layer having woven yarn and first a degree of crimp; and

providing a second fabric layer having woven yarns and a second degree of crimp.

12. The method of claim 7, wherein the step of providing at least two fabric layers comprises:

providing a first fabric layer that has a first degree of crimp in a section to be joined to a second fabric layer and has a second degree of crimp in a portion not joined to the second fabric layer.

13. The method of claim 7, wherein the step of providing at least two fabric layers comprises:

providing two fabric layers and a tape fabric layer.

14. The method of claim 13, wherein the two fabric layers include airship hull sections and the tape is used to join the hull sections together.

15. The method of claim 7, wherein the step of saturating at least facing surfaces comprises:

applying an adhesive to the fabric layers so that the adhesive encapsulates fiber bundles, but does not fully penetrate fiber bundles in the fabric layers.

16. The method of claim 7, wherein the step of saturating at least facing surfaces comprises:

applying an isocyanate-based urethane to the fabric layers.

17. The method of claim 7, wherein the step of providing an adhesive film comprises:

providing an extruded or cast resin film between the fabric layers.

18. The method of claim 7, wherein the step of providing an adhesive film comprises:

providing a cast or extruded urethane film having a thickness of at least 1.0 mm.

19. The method of claim 7, wherein the step of providing an adhesive film comprises:

providing an adhesive film having a thickness of at least 2 mm to a tape-type fabric layer.

20. The method of claim 7, wherein the step of providing an adhesive film comprises:

providing bonding agents in the adhesive film that are activated after exposure to a temperature above 300° F for a time of greater than 30 seconds.

21. The method of claim 7, where the step of applying heat and pressure comprises:

heating an adhesive film to a temperature near the melt point of the adhesive.

22. The method of claim 7 further comprising the step of applying a cold press cycle to said fabric layers wherein at least 100 psi of pressure is applied to said fabric layers until said layers cool to about ambient temperature.

23. The method of claim 7, wherein the step of applying heat and pressure comprises:

heating a urethane film to a temperature near 350° F.

24. The method of claim 7, wherein the step of applying heat and pressure comprises:

applying pressure to the fabric layers so that adhesive in the adhesive film is squeezed into open spaces in the fabric layers.

25. The method of claim 7, wherein the step of applying heat and pressure comprises:

applying a pressure of at least about approximately 100 psi to the fabric layers.

26. The method of claim 7, wherein the step of applying heat and pressure comprises:

applying heat and pressure to the fabric layers for a time between 30 and 60 seconds.

27. A method for joining at least two fabric layers, comprising the steps:

providing at least two fabric layers;

saturating at least facing surfaces of the fabric layers with an adhesive;

providing an adhesive film between the fabric layers;

applying heat and pressure to said at least two fabric layers so as to form a joint thereof;

monitoring the quality of said joint for voids in the adhesive; and

adjusting at least one joint formation parameter whereby said voids in the adhesive between the joined fabric layers are eliminated and avoided, said joint formation parameters comprising a group including adhesive film thickness, fabric layer weave openness, adhesive heating temperature, pressure applied to the joint during formation, a

time that the adhesive is maintained near its melting point, and a time that pressure is applied to the fabric layers.

28. The method of claim 27, wherein the step of monitoring the quality of said joint for voids comprises:

obtaining optical images of said joint indicative of opacity and clarity of weave pattern resulting from fiber and adhesive interface within said joint;

comparing said opacity and clarity of weave pattern in said optical images with that of a control image of a joint sample of desired quality, and

calculating the quality of said joint therefrom.

29. The method of claim 27, wherein the step of adjusting at least one joint formation parameter comprises:

applying a pressure of at least about approximately 100 psi to the joint.

30. The method of claim 27, wherein the step of adjusting at least one joint formation parameter comprises:

maintaining pressure on the joint for a time greater than 10 seconds.

31. A method for joining at least two fabric layers, comprising:

providing at least two fabric layers;

saturating at least facing surfaces of the fabric layers with an adhesive;

providing an adhesive film between the fabric layers;

performing at least one of:

heating the adhesive to a temperature near the melting point of the adhesive, and exerting a pressure of greater than or equal to 100 psi on the fabric layers; and maintaining at least one of said heating and said exerting a pressure for a time of at least 10 seconds.

32. The method of claim 31, wherein the step of performing comprises:

heating the adhesive to a temperature of 350° F;

exerting a pressure of at least about approximately 100 psi to the fabric layers; and

maintaining said pressure on the fabric layers for at least 10 seconds.

33. A method for determining the integrity of a fabric joint, comprising the steps:

determining an initial thickness of the fabric layers before being joined together;

determining a maximum joint thickness based on the initial thicknesses of the fabric layers;

measuring an actual thickness of a fabric joint formed from the fabric layers; and

comparing the actual thickness of the joint with the determined maximum joint thickness.

34. A method for joining at least two fabric layers, comprising the steps:

providing at least two fabric layers;

saturating at least facing surfaces of the fabric layers with an adhesive;

providing an adhesive film between the fabric layers; and

applying heat and pressure to the fabric layers until a sample of the joined fabric layers is reduced to not more than a predetermined optimal density for a joint of desired quality.

35. The method of claim 34, wherein the step of providing fabric layers comprises:

providing at least one fabric layer that includes fibers having a tenacity of 10g/denier or higher.

36. The method of claim 34, wherein the step of providing at least two fabric layers comprises:

providing two fabric layers extending in opposing directions from said joint and a tape fabric layer confined to said joint.

37. The method of claim 36, wherein the two fabric layers include airship hull sections and said tape fabric layer is used to join the hull sections together.

38. The method of claim 34, wherein the step of providing an adhesive film comprises:

providing bonding agents in the adhesive film that are activated after exposure to a temperature above 300° F for a time of greater than 30 seconds.

39. The method of claim 34, wherein the step of applying heat and pressure comprises:

applying a pressure of at least about approximately 100 psi to the fabric layers.

40. The method of claim 34, wherein the step of applying heat and pressure comprises:

applying heat and pressure to the fabric layers for a time between 30 and 60 seconds.

41. A fabric joint connecting abutting sections of fabric, comprising:

a composite fabric and adhesive laminate structure made from at least two fabric layers of which at least the facing surfaces of the fabric layers had been saturated with a thermoplastic adhesive, a thermoplastic adhesive film disposed there between, and heat and pressure applied thereto;

the pre-joining thickness of each said fabric layer and said thermoplastic adhesive film being known;

an optimal value of joint thickness for a said joint of desired quality having been calculated therefrom,

said composite fabric laminate structure comprising said fabric layers being bonded together in close proximity by said thermoplastic adhesive and said thermoplastic adhesive film wherein at least some fiber bundles of said fabric layers are encapsulated;

said composite fabric laminate structure having a thickness of not more than 15% greater than said optimal value of joint thickness.

42. The fabric joint of claim 41, at least one of said fabric layers comprising fibers having a tenacity of 10g/denier or higher.

43. The fabric joint of claim 41, said thermoplastic adhesive comprising an isocyanate-based urethane.

44. The fabric joint of claim 41, said at least two fabric layers comprising:

two fabric layers, each said layer extending from a respective side of said joint; and

one fabric tape layer confined therein.

45. A fabric joint connecting abutting sections of fabric, comprising:

a composite fabric and adhesive laminate structure made from at least two fabric layers of which at least the facing surfaces of the fabric layers had been saturated with a thermoplastic adhesive, a thermoplastic adhesive film disposed there between, and heat and pressure applied thereto;

the pre-joining density of each said fabric layer, said thermoplastic adhesive and said thermoplastic adhesive film being known;

an optimal value for joint density for a said joint of desired quality having been calculated therefrom,

said composite fabric laminate structure comprising said fabric layers being bonded together in close proximity by said thermoplastic adhesive and said thermoplastic adhesive film wherein at least some fiber bundles of said fabric layers are encapsulated;

said composite fabric laminate structure having a density of at least 85% of said optimal value for joint density.

46. The fabric joint of claim 45, at least one of said fabric layers comprising fibers having a tenacity of 10g/denier or higher.

47. The fabric joint of claim 45, said thermoplastic adhesive comprising an isocyanate-based urethane.

48. The fabric joint of claim 45, said at least two fabric layers comprising two fabric layers extending from opposing sides of said joint and one fabric tape layer confined therein.